This outline contains some questions which may help you to study for the final. Dates listed for the topics are the approximate dates when the material was covered in class. The exam will be based on class notes, and only those sections of each chapter that were discussed in class will be covered on the exam. Also, keep in mind that in some cases the material covered in class goes beyond the discussion in the book.

In addition, please review the homework assignments. Solutions to the homeworks are posted on the class website.

Chapter 9: Forces and Wind (April 6 to April 22)

* Force and acceleration (4/6)
  ○ What is wind, and how is it related to velocity? How do you apply Newton’s laws to the study of wind?
  ○ What are Newton’s first and second laws?
  ○ What are the four important forces which act to produce wind motions?

* Pressure, pressure gradients and the PGF
  ○ What is a pressure gradient? How can you determine the direction and strength of the pressure gradient force (PGF)? See figs. 9.16 - 9.18. (4/8)
  ○ What is hydrostatic balance, and how is it related to the PGF?
  ○ What is sea level pressure? What’s the difference between SLP and surface pressure? Why is SLP more useful than surface pressure?
  ○ What is a constant pressure (isobaric) chart? How are height contours at, say, the 500mb level related to pressure variations at the mean height of the 500mb surface? (4/15)
  ○ What are troughs and ridges? How are troughs and ridges at the 500mb level related to cold and warm temperatures beneath the 500mb level?
  ○ What is a pressure altimeter? How and why might your altitude change even though the pressure altimeter says you’re at the same height?

* The Coriolis force (4/15, 4/18)
  ○ Why doesn’t the wind blow directly from high pressure to low pressure?
  ○ What is solid body rotation, and how do you calculate it?
  ○ How is a baseball game on a merry-go-round different from a normal baseball game?
  ○ What are the four important properties of the Coriolis force? (4/18)
The Geostrophic Wind (4/18, 4/20)

- How does the Coriolis force affect a parcel, initially rest, placed in a region where pressure decreases to the north (a region with a north-south pressure gradient)? See fig. 9.23. (4/18,4/20)
- What is the balance of forces for an air parcel moving with the geostrophic wind?
- How can you determine the direction and speed of the geostrophic wind by looking at an isobaric chart?
- Jet streams:
  - What are they and where do you find them (altitude, latitude)? In what season are they most intense?
  - How are jet streams related to temperature contrasts? Why does the PGF increase with height between warm and cold air columns? (4/20)

Friction and frictional convergence (4/22)

- What is the boundary layer? How deep is it? What is the three-way balance of forces acting on air parcels in the boundary layer?
- What is the direction of motion of air parcels when the 3-way force balance is in effect? What are the directions of the forces with respect to the parcel’s motion and the isobars?
- Where do air parcels converge and diverge under the influence of friction (think spiral motions)? How is frictional convergence related to clear and cloudy skies? (figs. 9.29, 9.30, 9.33)

Chapter 12: Air Masses and Fronts (April 22 to April 29)

Air masses (4/22)

- What are air masses? How are they classified (c,m/A,P,T)? Where do they form? What are the typical paths along which air masses move into and across North America? What are the ideal conditions for air mass formation, and why?

Air mass modification (4/25)

- What is lake effect snow, what are the conditions for producing it, where do you find it?
- How is cP air converted into mP air?

Air mass weather

- What is air mass weather? What kinds of weather are associated with each air mass? What is the Pineapple Express?
* Fronts (4/25)
  • What are they? How are they characterized? How are they drawn?
  • How/why do occluded fronts form?
  • What are the five main indicators used to identify fronts? Can you find them on fig. 12.12?
  • Where are fronts in relation to surface highs and lows? How does SLP change as a front goes by?

* Clouds and precipitation along fronts (4/27):
  • What kind of clouds are associated with a cold front (fig 12.14)? Do you find them mostly ahead of or behind the front? Why? What does this have to do with conditional instability?
  • What clouds would you see as a warm front approached you (what type, at what level, in what order)?
  • Why are cold fronts steeper than warm fronts? How does this affect the size of the cloudy regions associated with warm and cold fronts? (4/25)
  • What is a frontal inversion? Are they associated with warm fronts or cold fronts? How do they affect the type of clouds and rain associated with the front?

* Occluded fronts
  • Why do occlusions form? What is an initial occlusion? What does a cross section through an initial occlusion look like?
  • Warm and cold occlusions: what are they, what’s the difference between them, what do cross sections through warm and cold occlusions look like? (figs. 12.19, 12.20)

Chapter 13: Midlatitude cyclones (April 29 to May 6)

* The polar front model (4/29)
  • What are the stages of the lifecycle of a midlatitude cyclone? (fig. 13.1) At what stage does the cyclone reach its maximum intensity? What is a triple point?
  • What is the primary source of energy for midlatitude cyclones? What is APE, and how is it related to fronts and air masses? Why does an occluded front have less APE than the cold and warm fronts from which it formed?

* Storm tracks (5/2)
  • What are the principal stormtracks and cyclogenesis regions for North America? (fig. 13.3)
  • What is lee cyclogenesis, and where does it occur?
○ What is a Nor’Easter? Where do you find them? How does northeasterly wind contribute to heavy snowfall?

○ Where do you find the most intense cyclones, over the land or over the ocean? When?

○ How can you determine the positions of warm and cold fronts by looking at the comma-shaped clouds seen in satellite images?

* Cyclones and upper-level flow

○ Divergence and convergence:
  ▶ What are they, what do they look like, how/why do they affect SLP? How are they related to rising and sinking air motion? (5/4)

○ Warm and cold advection:
  ▶ What are they? How/why does a surface low produce them? On which side of the low is the warm/cold advection?
  ▶ How do warm and cold advection affect the height of the 500mb level? In a developing cyclone, where do you expect to find the upper-level trough and ridge in relation to the surface low? What does it mean to say that developing cyclones tilt westward with height?

○ Vorticity and the upper-level trough/ridge pattern
  ▶ What is vorticity? How can fluids have vorticity without actually spinning? What is the pinwheel test? What is planetary vorticity?
  ▶ Which moves faster, air parcels or the trough/ridge pattern in which they’re moving? Where in the trough/ridge pattern do parcels have positive or negative vorticity? (5/6)
  ▶ Vorticity and divergence: why does divergence, in combination with the Coriolis force, lead to a reduction in vorticity? Where in the trough/ridge pattern do you find divergence/convergence as parcels gain/lose vorticity? How does the gain and loss of vorticity by parcels affect SLP?

○ How do the upper-level trough/ridge pattern and the surface low reinforce each other in a developing midlatitude cyclone?